Estimating cases for COVID-19 in South Africa
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Introduction

- South African COVID-19 Modelling Consortium
- Uncertainty regarding both the true scale and spatial distribution as a result of PUI criteria and testing coverage
- Models developed by MASHA, SACEMA and HE2RO in conjunction with the NICD
- Extensive and ongoing input from clinicians, virologists, intensivists and epidemiologists to refine key model assumptions and parameters
- Projections will be updated weekly
Projections in Context

- Projections at a population level do not capture clustering of cases
  - E.g. Sharp increases in cases in the Eastern Cape
  - A spatial model with additional granularity is required (forthcoming)

- Models project total need for hospital beds and ICU beds
  - Do not account for stricter criteria to entry and existing capacity

- Population behaviour/response to mortality
  - Lessons from Ebola epidemic (adaptive behaviour to decrease mortality)

- Projections will improve with new data
  - Hospitalisation (public and private)
  - Length of stay

- Short term vs Long term Projections
Users of model outputs

- Clinicians
- Public Health
- Laboratory
- Research
- Covid Modelling Consortium
- Costing Working Group
- National Health Laboratory Service
- Emergency Operations Centre
- National Institute of Communicable Diseases
- National Ventilator Project
- National Health Laboratory Service
- National Venilator Project
- Covid Conditional Grant
- National Treasury
- Minister of Public Works and Infrastructure
- Minister of Trade and Industry
- Minister of Health
- Presidential Covid Command Council
- Incident Response Committee
National COVID Models

- **National COVID-19 Epi Model**
  - Generalised SEIR model
  - Disease severity (asymptomatic, mild, severe, critical)
  - Treatment pathway (outpatients, non-ICU, ICU)

- **National COVID-19 Cost Model**
  - Inputs from a range of resources to represent the type, number and price of ingredients to cost response
  - Inform resource requirements and predict where gaps may arise based on available resources

### Diagram

Diagram showing the flow of disease progression with nodes for different stages of infection and treatment. Each stage is associated with specific numbers (1-16) that likely represent transition probabilities or time periods.
Two scenarios

Assumption: Level 4 continues until 31 May followed by social distancing measures

Optimistic scenario
- Lockdown reduced transmissibility by 60%
- Level 4 from 1 May to 31 May: 35%
- Social distancing measures after 31 May reduces transmissibility by 20%

Pessimistic scenario
- Lockdown reduced transmissibility by 40%
- Level 4 from 1 May to 31 May: 25%
- Social distancing measures after 31 May reduces transmissibility by 10%
Short-term projections

Detected Cases: 30,433 (18,710, 54,540)

ICU bed threshold (~3,300 beds)
Long-term projections
Long-term projections: Impact of lock-down

• Greater uncertainty

• Lockdown has flattened the curve and pushed the peak later

Key Assumption: Asymptomatic proportion of cases: 75%
Long term projections: National

Current trajectory of detected cases: Optimistic
Provincial Projections
Eastern Cape

Current trajectory of detected cases: Pessimistic

Free State

Current trajectory of detected cases: Better than optimistic
Current trajectory of detected cases: Optimistic

Gauteng

Kwa-Zulu Natal
Current trajectory of detected cases:

- **Limpopo**
- **Mpumalanga**
- **Northern Cape**
- **North West**

General bed threshold

Optimistic
Western Cape

Current trajectory of detected cases: Pessimistic
Conclusions

• The initial social distancing and lockdown measures have worked:
  • Epidemic curve has flattened and peak been delayed
  • Extension of lockdown to 5 weeks bought us critical additional time to ramp up community testing and prepare mitigation measures for the oncoming wave

• Peak in active cases likely between early July (pessimistic) and early Aug (optimistic). This will be affected by post-lockdown measures.

• Considerable variation in timing and scale of peaks between Provinces. Variation will be greater between districts and sub-districts.

• Under almost all scenarios hospital and ICU capacity will be exceeded though timing and extent is uncertain. Requires a flexible approach to resource acquisition with initial purchases now and additional orders as more information becomes available
### Disease severity with age-specific adjustment for South Africa

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Severe cases (hospitalized)</th>
<th>Critical (of severe)</th>
<th>Fatal (of critical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>10 to 19</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>20 to 29</td>
<td>10%</td>
<td>12%</td>
<td>5%</td>
</tr>
<tr>
<td>30 to 39</td>
<td>15%</td>
<td>16%</td>
<td>5%</td>
</tr>
<tr>
<td>40 to 49</td>
<td>21%</td>
<td>19%</td>
<td>7%</td>
</tr>
<tr>
<td>50 to 59</td>
<td>25%</td>
<td>23%</td>
<td>17%</td>
</tr>
<tr>
<td>60 to 69</td>
<td>31%</td>
<td>25%</td>
<td>28%</td>
</tr>
<tr>
<td>70 to 79</td>
<td>40%</td>
<td>30%</td>
<td>34%</td>
</tr>
<tr>
<td>80+</td>
<td>47%</td>
<td>30%</td>
<td>83%</td>
</tr>
</tbody>
</table>

Source: Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — CDC COVID-19 Response Team, United States, February 12–March 16, 2020

**Of those with symptomatic infection**

~96% Mild
~2.8% Severe
~1.2% Critical

Age-distribution taken into account, provincially and by social vulnerability index.
## Key Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value*(range)</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infection severity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of cases that are asymptomatic</td>
<td>75%</td>
<td>[1], [2], [3]</td>
</tr>
<tr>
<td>Mild to moderate cases among the symptomatic</td>
<td>(95.64%, 96.78%)</td>
<td>[5]</td>
</tr>
<tr>
<td>Severe cases among the symptomatic</td>
<td>(2.46%-3.64%)</td>
<td></td>
</tr>
<tr>
<td>Critical cases among the symptomatic</td>
<td>(1.16%-1.45%)</td>
<td></td>
</tr>
<tr>
<td>Proportion of cases that are fatal</td>
<td>(0.30%, 0.412%)</td>
<td>[4], [5]</td>
</tr>
<tr>
<td><strong>Timeframes &amp; treatment durations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time from infection to onset of infectiousness</td>
<td>4 days (2-0-9-0)</td>
<td>[4], [6], [7], [8], [9], [10] with input from analysis of NICD data.</td>
</tr>
<tr>
<td>Time from onset of infectiousness to onset of symptoms</td>
<td>2 days (1-0-4-0)</td>
<td></td>
</tr>
<tr>
<td>Duration of infectiousness from onset of symptoms</td>
<td>5 days</td>
<td></td>
</tr>
<tr>
<td>Time from onset of mild symptoms to testing</td>
<td>4 days (2.0-4.0)</td>
<td></td>
</tr>
<tr>
<td>Time from onset of symptoms to hospitalisation</td>
<td>5 days (4-0–8-0)</td>
<td></td>
</tr>
<tr>
<td>Time from onset of symptoms to ICU admission</td>
<td>9 days (8-0–17-0)</td>
<td></td>
</tr>
<tr>
<td>Duration of hospital stay</td>
<td>12 days (7-0–16-0)</td>
<td></td>
</tr>
<tr>
<td>Duration from ICU admission to discharge</td>
<td>18 days (14-0–18-0)</td>
<td></td>
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<tr>
<td>Duration from ICU admission to death</td>
<td>5 days (4-0-7-0)</td>
<td></td>
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</tbody>
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* Parameter values have been selected for use by an expert panel of clinicians on the SA Covid-19 Modelling Consortium. Ranges are informed by sources.

References